FOR SAFETY'S SAKE

BY JOAN PALLIX

BACK IN THE MID-1980S AN ISRAELI FIGHTER PILOT COLLIDED WITH ANOTHER VEHICLE DURING A TRAINING MISSION. THE WING WAS TORN FROM HIS F-15 DOWN TO THE WING ROOT. HIS TRAINER ORDERED HIM TO EJECT, BUT THIS HIGHLY SKILLED PILOT REFUSED AND PROCEEDED TO STABILIZE THE AIRCRAFT BY USING HIS REMAINING CONTROLS IN A HIGHLY UNCONVENTIONAL MANNER. HE MANAGED TO DO THE IMPOSSIBLE BY SAFELY LANDING A SINGLE-WINGED PLANE.

THAT S VERY, VERY HARD TO DO. IN A SIMULATION AFTER the incident, it was found that only one in ten of the pilot's peers could have successfully completed that same maneuver. Ideally, of course, we want to develop technology that enables all pilots to have the same capability to land safely.

These mishaps aren't just happening to military aircraft, either. In the past 20 years, there have been a number of commercial aircraft mishaps resulting from loss of primary control systems. For example, there was a serious incident in Sioux City, Iowa with a DC10 carrying a full load of passengers. An engine component failed and exited the engine compartment, penetrating the fuselage and severing the hydraulics required to manipulate the aircraft control surfaces. Under normal circumstances this would result in an uncontrolled crash. As luck would have it, one of the passengers on the plane was a pilot who had just completed 100 hours of engine-only flight training, which involves flying without surface controls. He recognized that there was a problem on the plane and made his way to the cockpit to offer his help. Amazingly, this experienced passenger and pilot worked together to crash-land the plane, saving more than half of the lives of the passengers. All would have been lost if not for the unique experience of this unexpected passenger.

PUSHING FORWARD

Recognizing these stories as representative of a national technological need, my group at the NASA Ames Research Center, Resilient Systems and Operations, began funding technology development to enable seriously damaged aircraft to autonomously

SO WHY DEVELOP CONTROL TECHNOLOGIES IN THE FIRST PLACE?

"We had all these organizations—the NASA Integrated Action Team, the Shuttle Independent Assessment Team, and the U.S. Air Force—looking at accidents like the Arian Shuttle and the Challenger and asking why," explains Joan Pallix, of the NASA Ames Research Center. "One of the things they found is that we don't have any systems that understand when there is something wrong with them and can autonomously diagnose their problems."

Pallix says that this technology will become essential for ensuring the safety of vehicles like airplanes and spacecraft. "Until now we've had no way to test vehicle's complex systems to make sure that what we've built is right," she says. "Usually a problem has to do with a failure in the structure of the vehicle, or the propulsion system, or the control system. That's why we are focusing on intelligent flight control."

There are hundreds of things that can go wrong inside a vehicle, but Pallix and her team are developing flight software that will eliminate the most common sources of failure. What's unique about it? "The 'neural net' is a system that actually learns," she says. "It notices when the pilot tries to do something and the plane doesn't react. Then it reuses the surfaces to make it happen."

regain control. We had started to develop and flight test an intelligent flight control system, or "neural net controller," designed to adapt to the loss of various control surfaces and devices on commercial planes and spacecraft. We believed it would be revolutionary in changing the level of safety on these vehicles.

Our conviction wasn't enough proof for NASA Headquarters and Congress; good ideas abound, but budget is limited. They needed to see a clear future in our project and a definite plan to infuse the technology into future aircraft or they'd cut our funding. The Federal Aviation Administration (FAA) is responsible for safety regulations in the national airspace and helps government agencies to make this type of funding decision. Historically we've had trouble getting the FAA on board. They wouldn't back a project just because it was supposed to make things safer. They'd need to see research on how the system works with a human being in the cockpit—and that takes time.

Still, FAA support was important for the project, I made it my mission to write the requirements in a way that put it on track for success. I didn't simply tell the people on the program that FAA buy-in was important, I went a step further. I wrote it into the actual requirements that we get FAA agreement. By placing that on the project's "critical path," I knew that the issue would get attention.

Though the FAA typically deals with the certification of finished products, I knew that having their support up front would give us a much better chance of survival with Headquarters and Congress. At first, my efforts were ignored. They weren't interested in spending time on a speculative project at such an early stage of development.

They didn't want to talk to us about a system until some company said, "We're going to put it in our vehicle." No company was going to put it in their vehicle unless they knew that it was certifiable and cost effective. Congress wouldn't and shouldn't fund a system that no one was committed to putting in their aircraft. It was something of a Catch-22 as far as funding goes.

A LITTLE HELP FROM OUR FRIENDS

I realized that I couldn't do it alone, so I made a new plan: I started networking. I used my contacts to get someone's attention at the FAA. We do a lot of work with pilots and researchers inside our NASA organization stationed at Dryden who, in turn, have a lot of direct contact with the folks at the FAA—so we enlisted their help.

We know the Dryden people well since they fly all the software we develop. I was able to convince one of the guys there to help me push it through. I explained to him that our program wouldn't have credibility unless we found an advocate at the FAA, someone who would say, "Hey, I'm interested in this; it could be the wave of the future," and convince their bosses to let them go and have a look.

He understood how important the project was, and he worked hard to reach an agreement with the FAA. They were reluctant to commit to a standard certification process for a project that wasn't even finished—but they finally agreed to what they a called "mock certification" process for our system.

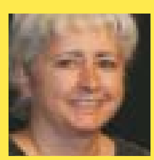
This was a major success! We had gotten the go-ahead to work on our experimental project, and we could test it with our provisional certification. This was exactly the "green light" we needed to ensure continued funding for our work on the neutral net. •

Lessons

- Sometimes the success of a project is determined by how much you believe in it and how much you are willing to push. New development projects are never handed out readymade; you have to be willing to shape it and keep it moving whether you have initial support or not.
- It is important to know the politics involved in the approval of your project. You need to not only know what you're selling, but who you're selling to.

Question

Is it the role of the project manager, or the project sponsor to scan the project's external environment and maintain constant communication with the project's stakeholders?



JOAN PALLIX earned her Ph.D. degree in chemical physics from Yale University in 1987. With a diverse background in quantum dynamics, chemistry, laser spectroscopy, materials science and solid-state diagnostics, diagnostic instrumentation, measurement systems, and optics, she has published numerous papers in those areas. Over the last ten years, she has held various supervisory and managerial positions for scientific research and engineering projects at NASA. Pallix currently manages the Resilient Systems and Operations project at NASA Ames Research Center.